

## ELECTRONIC DISPLAY CROSS-TALK COMPENSATION SYSTEMS AND METHODS

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/923,373, “ELECTRONIC DISPLAY CROSS-TALK COMPENSATION SYSTEMS AND METHODS,” filed Oct. 18, 2019, which is herein incorporated by reference in its entirety for all purposes.

### SUMMARY

[0002] A summary of certain embodiments disclosed herein is set forth below. It should be understood that these aspects are presented merely to provide the reader with a brief summary of these certain embodiments and that these aspects are not intended to limit the scope of this disclosure. Indeed, this disclosure may encompass a variety of aspects that may not be set forth below.

[0003] In general, the display of an electronic device may be compactly packaged with other components, for example, to reduce the size of the overall electronic device and/or allow space for additional components. Additionally, the density of pixels in the display may be increased for increased resolution and fidelity. However, the close proximity of electrical signals routed to and from the various components of the electronic device, including the pixels, may result in “cross-talk” (e.g., parasitic capacitance, current leakage, voltage variations, and other forms of electromagnetic interference) within the pixel circuitry (e.g., data lines, reference voltage lines, etc.) and/or between the pixel circuitry and other components of the electronic device, such as touch sensor circuitry. Such cross-talk may lead to variations in luminance of the pixels, which may manifest as perceivable artifacts on the display. The present disclosure generally relates to systems and methods for compensating the image data sent to the pixels of an electronic display for cross-talk within the pixel circuitry and/or between the pixel circuitry and the touch sensor circuitry. This may counteract the effect of cross-talk before the image data even reaches the display.

[0004] For example, in some embodiments, a touch stimulus signal may be employed in the touch sensor circuitry to facilitate detecting a user input (e.g., a finger or stylus touching the electronic device) and/or determining the placement of the user input relative to the electronic display. However, the touch stimulus signal may cross-talk with the pixel circuitry causing variations in the luminance output of the pixels. In some embodiments, the electronic device may compensate the image data to the pixels based on the frequency of the touch stimulus signal and/or the location of the pixels on the display panel. The compensation to the image data may increase or decrease the voltage of the data signal sent to a pixel to counter the cross-talk from the touch sensor circuitry (e.g., the touch stimulus signal).

[0005] Additionally or alternatively, cross-talk may occur between data lines, reference lines, or other conductive lines within the pixel circuitry. For example, a reference voltage (e.g., VDDEL or VSSEL) of the pixels may cross-talk with one or more data line voltage signals of the pixels causing the difference between the reference voltage and the data line voltage signal of a given pixel and, therefore, the apparent applied signal to the pixel to increase or decrease.

In some embodiments, the electronic device may counter the cross-talk between the conductive lines within the pixel circuitry by anticipating an increase or decrease to the reference voltage and adjusting the image data accordingly to maintain the desired apparent applied signal (e.g., associated with the image data) to the pixel. Moreover, in some embodiments, the anticipated change in the reference voltage may be determined based on the aggregate of multiple pixel transitions (e.g., changes in the data line voltage signal from one row of pixels to the next).

[0006] Various refinements of the features noted above may exist in relation to various aspects of the present disclosure. Further features may also be incorporated in these various aspects as well. These refinements and additional features may exist individually or in any combination. For instance, various features discussed below in relation to one or more of the illustrated embodiments may be incorporated into any of the above-described aspects of the present disclosure alone or in any combination. The brief summary presented above is intended only to familiarize the reader with certain aspects and contexts of embodiments of the present disclosure without limitation to the claimed subject matter.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Various aspects of this disclosure may be better understood upon reading the following detailed description and upon reference to the drawings in which:

[0008] FIG. 1 is a block diagram of an electronic device including an electronic display, in accordance with an embodiment;

[0009] FIG. 2 is an example of the electronic device of FIG. 1, in accordance with an embodiment;

[0010] FIG. 3 is another example of the electronic device of FIG. 1, in accordance with an embodiment;

[0011] FIG. 4 is another example of the electronic device of FIG. 1, in accordance with an embodiment;

[0012] FIG. 5 is another example of the electronic device of FIG. 1, in accordance with an embodiment;

[0013] FIG. 6 is a block diagram of a portion of the electronic device of FIG. 1 including a display pipeline that has cross-talk compensation circuitry, in accordance with an embodiment;

[0014] FIG. 7 is a block diagram of a portion of the display pipeline of FIG. 6 including the cross-talk compensation block, in accordance with an embodiment;

[0015] FIG. 8 is a schematic diagram of pixel circuitry, in accordance with an embodiment;

[0016] FIG. 9 is a schematic diagram of a portion of an electronic display, in accordance with an embodiment;

[0017] FIG. 10 is a schematic diagram of a portion of the electronic device including a touch sensor sub-system, in accordance with an embodiment;

[0018] FIG. 11 is a schematic diagram of cross-talk between a touch layer and a display layer of the electronic device, in accordance with an embodiment;

[0019] FIG. 12 is a depiction of visual artifacts on an electronic display such as banded patterns, in accordance with an embodiment;

[0020] FIG. 13 is a flowchart of an example process for compensating image data for touch sensor cross-talk, in accordance with an embodiment;